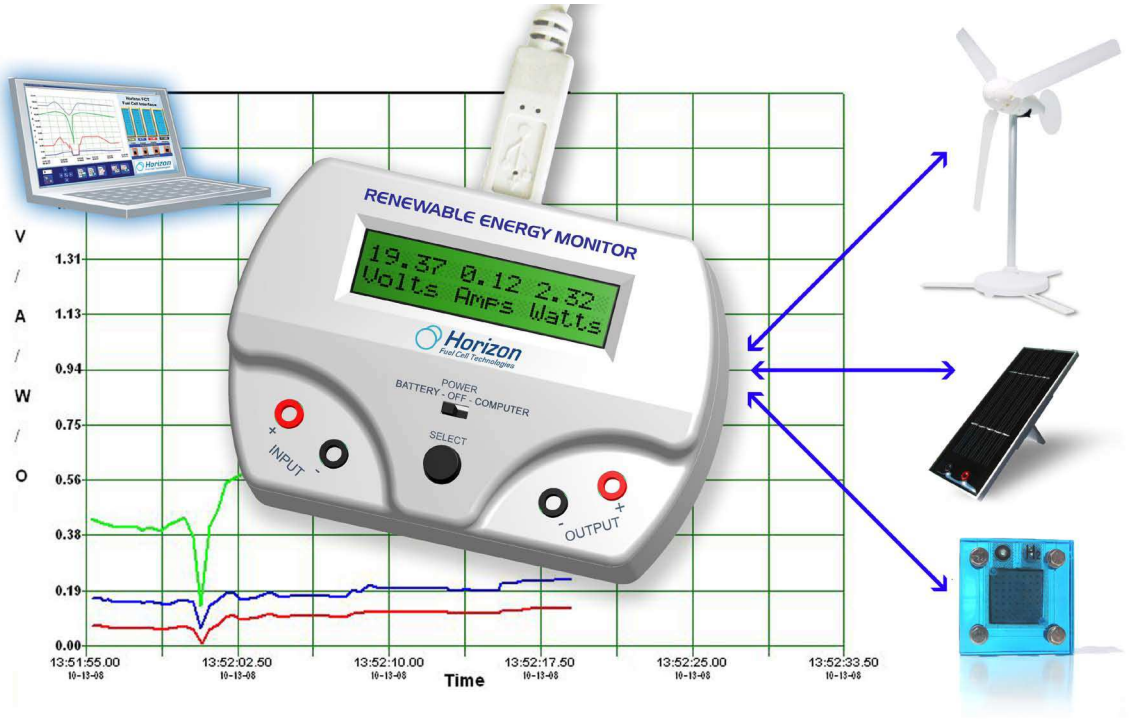
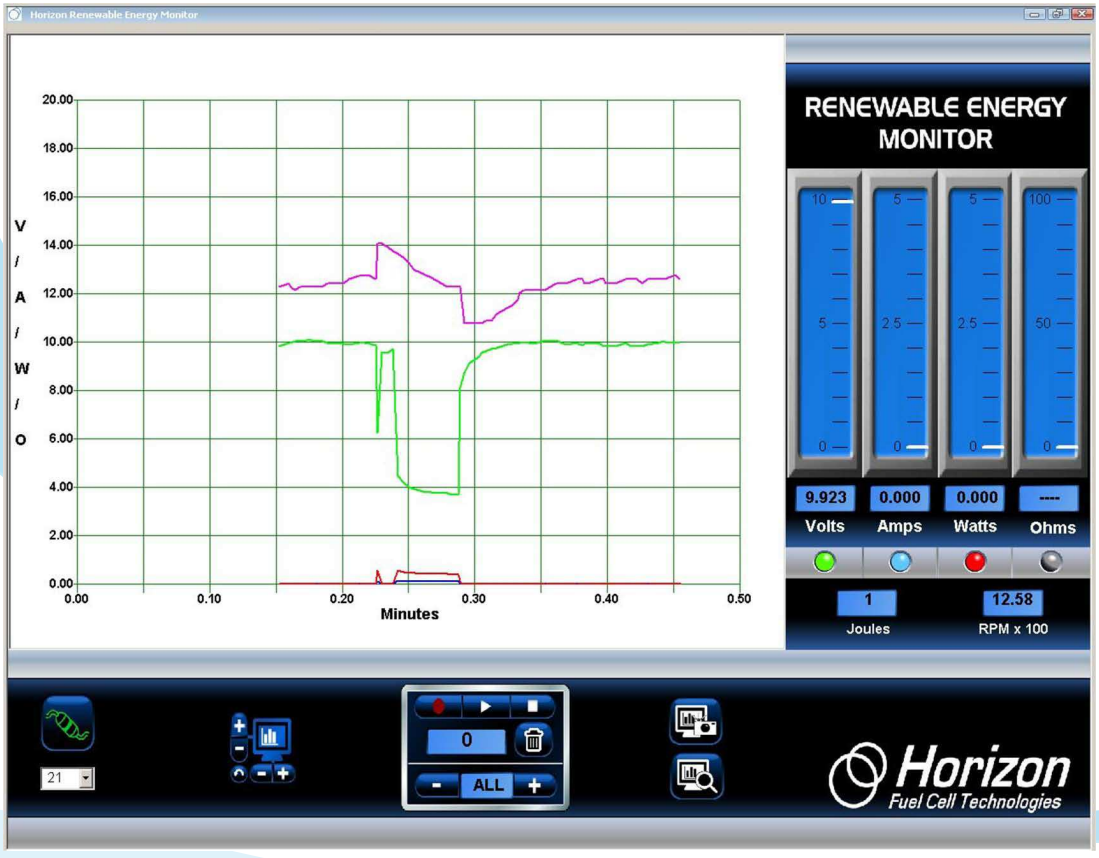
Horizon
Renewable Energy Monitor
User Manual
And
Software Reference Guide





Introducing the Horizon Renewable Energy Monitor

The **Renewable Energy Monitor** is an educational evaluation monitoring device with PC measurement software for graphical display of performance characteristics on its own 2 line LCD screen or your Windows computer. It has a 2 line LCD screen for viewing measurements that you cycle through just by pushing a button.

And the **Renewable Energy Monitor** is battery operated and comes with a USB port so it can also be used with or without a computer – indoors or outdoors – where you can make direct solar and wind measurements.

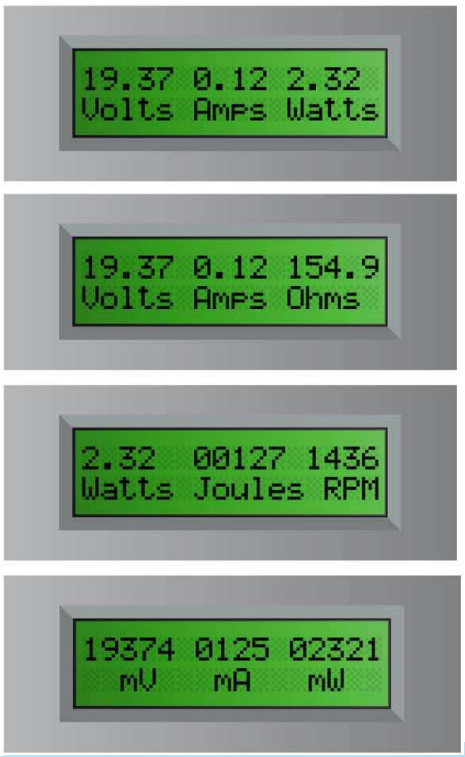
And its power is in its simplicity!

Horizon developed **the Renewable Energy Monitor** to allow you to avoid using the multimeters confusing setup and cumbersome computations in order to provide an immediate, graphical way for recording data directly with no formulas and nothing to calculate. Numerous experiments and evaluation activities for hydrogen fuel cells, miniature wind turbine kits, and solar panels are now quantifiable in real time for voltage, current, power, joules, resistance, and even wind turbine RPM speed – all viewable and recordable at the same time!

The **Renewable Energy Monitor** is fully compatible with any of Horizon's educational kits.

Screens

Just push the Select button to cycle through the following screens:



Switches

There are only two switches to operate:

- **Battery – OFF - Computer**
- **Select**

Set it to Battery when you want to make your measurements outside or without using a **computer**, or set it to Computer when it's plugged into your computer using the supplied USB cable. And set it to **OFF** when it's not in use.

Push the **Select** button to cycle through the four main LCD screens. You can even hold the **Select** button to "freeze" the display if the numbers are changing too fast.

USB Connection

A USB "type B" connector on the back of the unit allows connection to a Windows PC computer (MAC computers are not supported at this time). Power for the **Renewable Energy Monitor** is supplied by the PC via the USB cable.

Battery Requirements

The **Renewable Energy Monitor** uses a standard 9 volt radio battery that is easily replaced when necessary. The LCD screen will indicate when the battery is low and needs replacement. Be sure to set the switch to **OFF** to extend the battery life when not in use.

Units of Measurements

The **Renewable Energy Monitor** measures standard electrical units like voltage, current, power, energy and resistance. It also measures the RPM speed of the WindPitch wind turbine.

Voltage is measured in volts or millivolts (mV). A millivolts is 1/1000 of a volt but when seen on the LCD screen it can provide a more accurate measure of the voltage. For example…

1.23 volts = 1230 mV
10.456 volts = 10456 mV

Current is measured in amps or milliamps (mA). A milliamp is 1/1000 of an amp. For example…

0.003 amps = 3 mA
1.256 amps = 1256 mA

Power is measured in watts or milliwatts (mW). A milliwatt is 1/1000 of a watt. For example…

0.034 watts = 34 mW
2.987 watts = 2987 mW

Energy is measured in Joules. Energy is basically power x time and one Joule is equal to one watt-second. For example.

21 Joules = 21 watt-seconds or the amount of power used in 21 seconds.

RPM is a measure of the rotational speed of the wind turbines blades. RPM is used in experiments to show how the above parameters are affected by higher or lower RPM rates.

Input and Output Terminals

There are two sets of **Input** and **Output** terminals. The **Input** terminals are on the left side and the **Output** terminals are on the right side of the unit. The Red terminal is + or positive while the Black terminal is – or negative. You must observe the correct polarity when hooking up batteries, solar panels, wind turbines or fuel cells to the terminals.

Specifications

The **Renewable Energy Monitor** will measure electrical parameters up to the following limits:

Voltage:	**0 - 28 VDC**
Current:	**0 - 1 amp DC**
Power:	**0 - 28 watts**
Resistance:	**0 - 999 ohms**
Energy:	**0 - 65535 Joules**
RPM:	**200 - 2500**

Note: very low and very high RPM speeds cannot be accurately measured. Even though the wind turbine may be spinning the electronic circuitry is only capable of measuring a certain range of RPM speeds. Low voltage outputs from the WindPitch wind turbine may also affect RPM accuracy.

Common Equations

The Renewable Energy Monitor uses the following common equations internally to measure and compute voltage, current, resistance and power.

V = I * R where V = voltage
I = current
R = Resistance

P = V * I where P = power
V = voltage
I = current

J = P * T where J = Joules
T = time in sec

Operating Tips

Electrical Fundamentals – Refer to the **REES Experiment Manual** for an explanation of the fundamental electrical parameters such as voltage, current, power, resistance and more.

Measuring Resistance – A voltage must be applied across the Input terminals in order to measure the resistance attached to the Output terminals.

Also, the resistance will vary depending on the voltage and current produced in the circuit. The **Renewable Energy Monitor** uses Ohm's Law to compute resistance, so any small variations in voltage and current will affect the resistance reading.

Software

Software for Windows PCs (XP, Vista and Windows 7) is provided to expand the operational capabilities of the **Renewable Energy Monitor**. MACs are currently not supported. Connect the USB cable between the Monitor and your computer for vivid graphical displays of data.

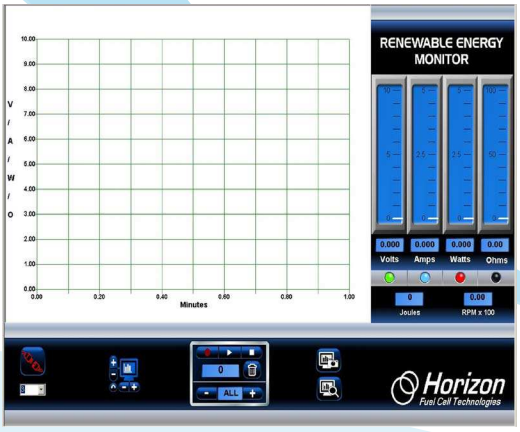
Installing the Software

Insert the supplied CDROM disc into your computer and follow the directions in order to load the software.

Running the Software

After the software is installed on your computer a Desktop icon like the one here is displayed. Double-click the icon to launch the software.

Tip: Always attach the USB cable between the Renewable Energy Monitor and the computer BEFORE you click on the REM icon to start the software. Then click on the Connect icon once the software is visible on your computer.



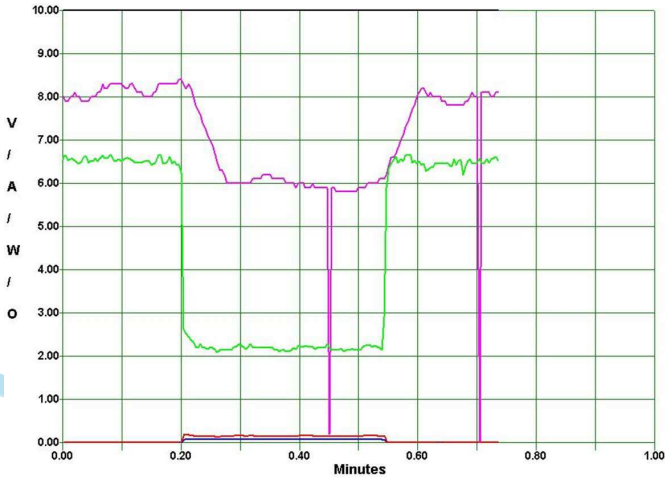
Connecting

Once the software is displayed on your computer screen, click the Connect icon on the bottom-right of the screen. It will turn from red to green to show that it is connected to the **Renewable Energy Monitor**.

Tip: Nothing will happen unless you click the Connect icon and the number below it represents the com port attached to the Renewable Energy Monitor. Refer to the "More Details" section for a further explanation.

Plot Area

The plot area displays the line plots of voltage, current, power, resistance and RPM – all at the same time. This data is updated five (5) times a second from the Renewable Energy Monitor so it always represents the latest information coming from your experiments.



Color-Coded Plotting Lines

Each data plot is in a different color in order to make it easy to see what is being measured.

Green - **Voltage in volts**
Blue - **Current in amps**
Red - **Power in watts**
Black - **Resistance in ohms**
Pink - **RPM x 100**

Adjusting the Plot Scale

You can change the plot scale to match the incoming data from the Renewable Energy Monitor by using the Plot Scale icon. The vertical + and – control the vertical scale while the horizontal + and – control the time scale. Clicking the reverse arrow icon (bottom-left) clears the screen and allows a fresh plot of data to be displayed.

Meters and LED On-Off buttons

Four vertical meters display the voltage, current, power and resistance along with corresponding numbers at the bottom. Clicking any of the LED buttons at the bottom of each meter turns the corresponding plot line ON or OFF. The LEDs are color coded to match the plot lines to make it easier to understand.

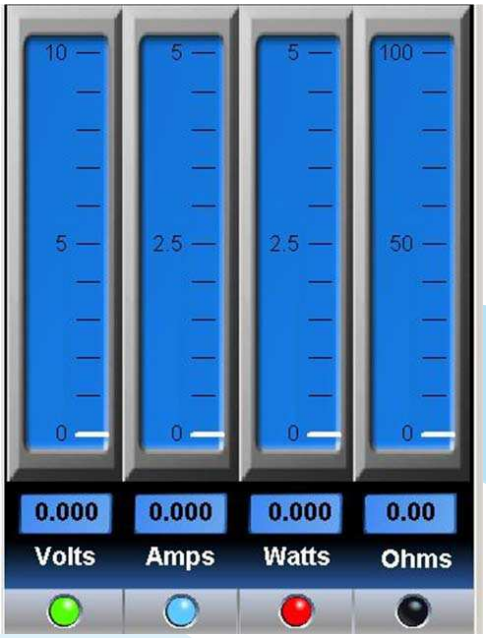
Joules and RPM Display

Joules is a measure of energy (power x time). It is equivalent to a watt-second or the number of watts generated in one second and shows how much energy the experiment is generating.

RPM is displayed as RPM x 100 in order to better fit in the plot area. For example an RPM reading of 1436 is shown as 14.36.

Screen Snapshots

You can capture a snapshot of the screen at anytime by clicking the top Screen Capture icon. Then click the Screen View icon below it to see what you captured.



Data Recording and Playback

The built in recording feature is like recording a TV show for later playback except that you're using data coming from the **Renewable Energy Monitor** instead. The Recording and Playback controls are shown here.

The top three controls are…

Record Play – Pause Stop

Recording Data

Click the (round) Record icon to start recording data. The icon will change to a brighter red color.

Stop Recording

Click the (square) Stop icon when you're done recording. The Stop icon will momentarily change color from white to green – then back to white again. The red Recording icon will also turn off and the plot will go back to real time.

Play and Pause

Click the (triangle) Play icon to begin replaying the recorded data. The Play icon will change from white to green during playback.

You can Pause the playback by clicking again on the (triangle) Play icon. It will change from a green triangle to a green double line. Click the Pause icon again to resume playback.

Recording Counter

The Recording Counter indicates the number of data samples that are (or have been) recorded for later playback. It can range from 1 to 999.

The Trash Icon

Click the Trash icon to erase all the recorded data. This will also reset the time on the plot area back to 0.0 minutes. You can push the Trash icon anytime; just make sure you really want to erase all the recorded data.

Sample Rate

You can control the rate at which you sample data by clicking the + or – icons on the Sample Rate indicator.

The default is ALL which means that all data from the Renewable Energy Monitor is recorded. Clicking the minus icon will slow the sample rate to the following:

Once each second ….

Every 2 seconds ….

Every 5 seconds ….

Every 10 seconds ….

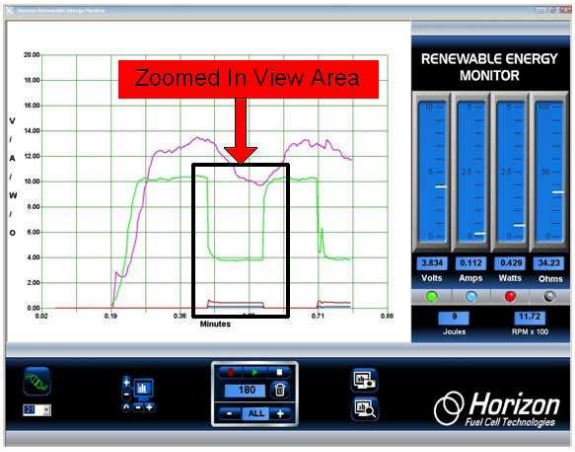
Every 15 seconds ….

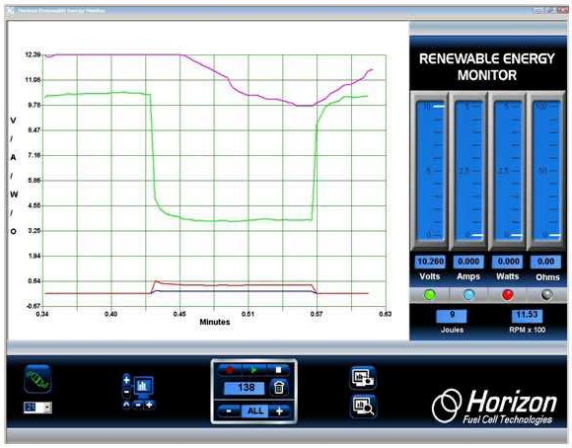
Every 30 seconds ….

Every 60 seconds ….

Zooming

While plotting data in real time or replaying data after recording, you can zoom in on a portion of the data at anytime. Simply position the mouse cursor over the area you want to zoom in to and click the left mouse button. Then release the left mouse button to execute the zoom feature.





More Details ……..

This section gives you more in depth information on important topics of interest (and possible confusion).

The Stop and Trash Icons

The Trash and Stop icons are the most important controls for plotting.

If plotting seems to stop or not do what you want it to do, it may be because the Stop icon was not clicked. Make sure to click the Stop icon after each recording.

The Trash icon not only erases all the recorded data, it also controls the time scale on the plot area. Click the Trash icon to reset the (horizontal) time scale to start at 0.0 minutes again. When in doubt, click both of them to get back to normal plotting.

The Recycle Icon

Click the Recycle icon to set the plot scales back to default settings.

The Connect Icon

Before any plots can occur, the graphic software must connect with the **Renewable Energy Monitor** that is transmitting data.
Normally the number just below the Connect icon is the right com port number; however, sometime you must select a different number to make the plotting work.

To do so, first select the correct Comm port number. **Click on the arrow next to the number to see if a higher number Comm port is displayed. If so, it's probably the one to use.** When in doubt, find the correct Comm port on your PC by going to **Control Panel -> System -> Hardware Manager -> Device Manager** then click on Comm port. Since you are using a USB connection rather than the traditional RS-232 connection, the Comm port number is not dependent on hardware so much, but rather on software settings in the **Control Panel** of the Windows operating system.

When correct, the Connect icon will show that the connection is made. If the Comm port is still not correct an error message will be displayed, which is usually due to the Comm port already in use by another Windows application.

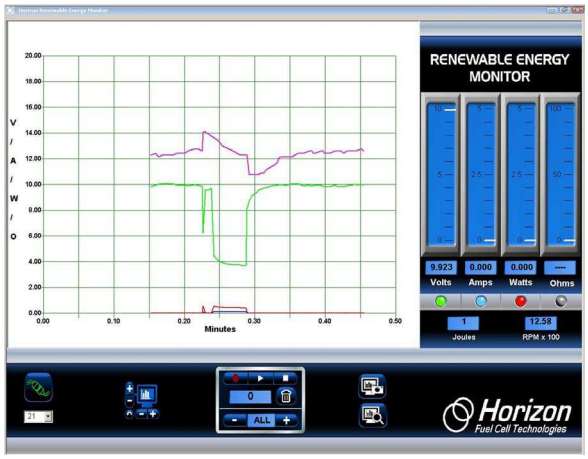
Screen Capture and View Icons

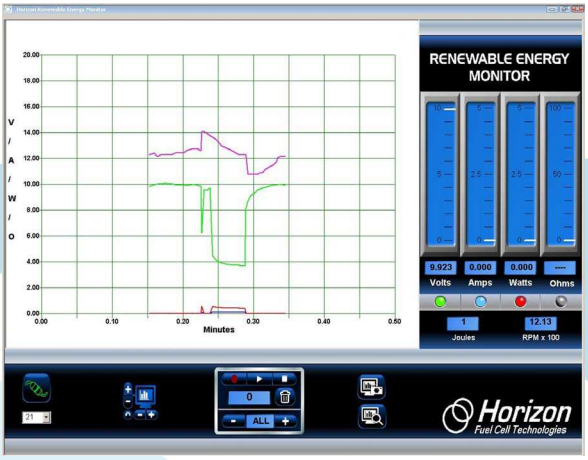
An important feature of the software is its ability to capture a snapshot of the screen at anytime. This way you can save important images including plots and meter data for later review.

For example, to take a snapshot of the entire scree click the top Screen Capture icon – the one with the camera.

To view the captured snapshot, click the Screen View icon – the one with the magnifying glass.

All the snapshots are saved to the computers hard disk. Just look under C:/Desktop/ Documents/ Horizon where you will find a listing similar to this. Each snapshot is labeled REM along with the date and time it was captured, so it should be easy to locate using the Search function.





Renewable Energy Monitor Excel ® Interface Addendum

In addition to its already powerful real time graphical plotting and data logging software, the latest version of **Horizon's Renewable Energy Monitor** comes with the ability to transfer the logged data to an Excel ® spreadsheet.

Here's how it works….

By using the software's Recording and Playback features, each time a new Record – Stop or Record –Play sequence is performed, an Excel ® compatible CSV (comma separated variable) file t is written to the hard disk. The file name begins with the letters REM and contains the date and time the recording was begun.

Example:
REM_05_31_11_at_15_44_03

By simply importing this file into your Excel ® spreadsheet you can do further analysis on the recorded data including plotting the variables in any order or style that suits your application.

The CSV files can be found on your hard disk in the same folder as the captured screen .jpg files. Just look under
C:/Desktop/ Documents/Horizon/file

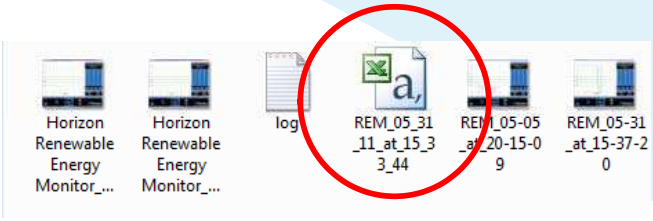
Example

1. To start a Recording, click the red REC button. It will change from dull to bright red indicating that data is being recorded.

2. At the same time a new CSV text file is opened and the incoming voltage, current, power, resistance, RPM and Joule data are saved in the file.

3. To end the recording, click the triangular Play or square Stop button. The REC button will turn dull red again and the Play or Stop button will turn green. This will also close the CSV text file where it can be imported into Excel ®.

4. To locate the CSV text file go to **C:/Desktop/ Documents/Horizon** folder where you will find the file mixed in with other previously saved screen capture images. If your folders are set to view files as icons you should see something like this.

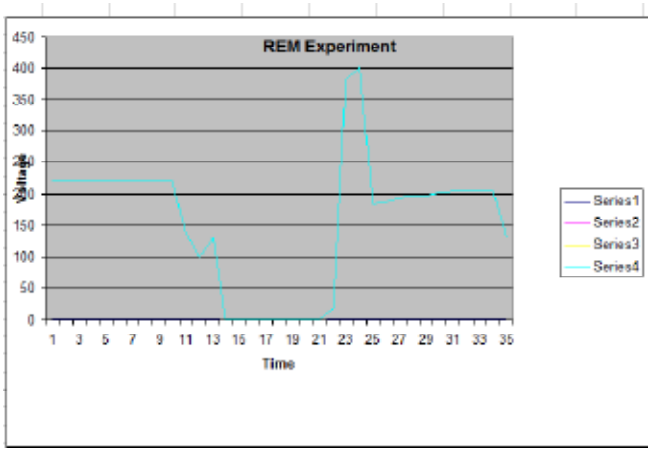


5. The file with the Excel ® logo is the one(s) you want to use to import into Excel ®.

6. To import the file into Excel ® you can 1) simply double-click on it or 2) launch Excel ® manually, find the folder and open the file normally. The data should look something like this →

	A	B	C	D	E	F	G	H
1	Date	Time	Sample	Plot Seconds	Voltage	Current	Power	Resistance
2	06/02/11	12:59:59	1	3	6.005	0.053	0.318	113.3
3	06/02/11	12:59:59	2	3.25	6.03	0.053	0.32	113.77
4	06/02/11	12:59:59	3	3.52	6.142	0.053	0.326	115.89
5	06/02/11	12:59:59	4	3.75	6.03	0.053	0.32	113.77
6	06/02/11	13:00:00	5	4.03	5.976	0.053	0.317	112.75
7	06/02/11	13:00:00	6	4.27	6.059	0.053	0.321	114.32
8	06/02/11	13:00:00	7	4.48	6.005	0.053	0.318	113.3
9	06/02/11	13:00:00	8	4.75	5.976	0.053	0.317	112.75
10	06/02/11	13:00:01	9	5	6.005	0.053	0.318	113.3
11	06/02/11	13:00:01	10	5.3	5.947	0.053	0.315	112.21
12	06/02/11	13:00:01	11	5.53	5.947	0.053	0.315	112.21
13	06/02/11	13:00:01	13	5.76	5.893	0.053	0.312	111.19
14	06/02/11	13:00:02	14	6.04	5.893	0.053	0.312	111.19
15	06/02/11	13:00:02	15	6.28	5.918	0.053	0.314	111.66
16	06/02/11	13:00:02	16	6.54	5.893	0.053	0.312	111.19
17	06/02/11	13:00:02	17	6.79	5.947	0.053	0.315	112.21
18	06/02/11	13:00:03	18	7.03	6.005	0.053	0.318	113.3
19	06/02/11	13:00:03	19	7.28	6.005	0.053	0.318	113.3
20	06/02/11	13:00:03	20	7.54	5.918	0.053	0.314	111.66
21	06/02/11	13:00:04	21	7.81	5.976	0.053	0.317	112.75
22	06/02/11	13:00:04	22	8.03	5.947	0.053	0.315	112.21
23	06/02/11	13:00:04	23	8.28	5.918	0.053	0.314	111.66
24								
25								
26								

7. You can then proceed to manipulate the data in anyway you choose including generating plots directly from it.



Refer to Horizon's **Renewable Energy Monitor User Manual and Software Reference Guide** for a complete description of all the software features.

The new Excel ®feature is available in software version 1.10 and above.